

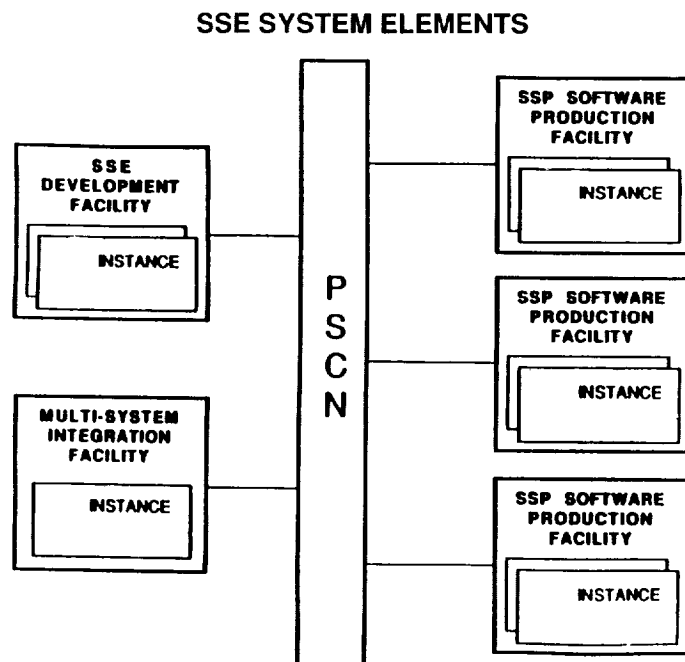
SUPPORT FOR LIFE-CYCLE PRODUCT REUSE IN NASA'S SSE

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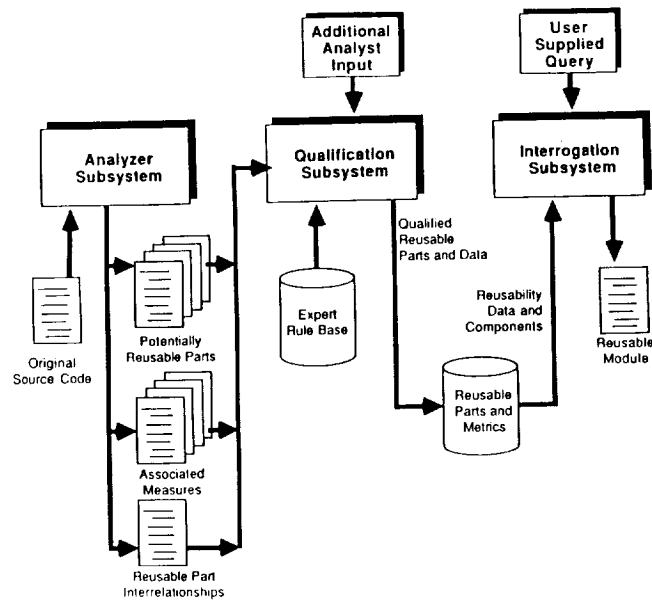
The Software Support Environment (SSE) is a software factory for the production of Space Station Freedom Program operational software. The SSE is to be centrally developed and maintained and used to configure software production facilities in the field. The PRC product TTCQF provides for an automated qualification process and analysis of existing code that can be used for software reuse. The interrogation subsystem permits user queries of the reusable data and components which have been identified by an analyzer and qualified with associated metrics. The concept includes reuse of non-code life-cycle components such as requirements and designs. Possible types of reusable life-cycle components include templates, generics, and "as-is" items. Qualification of reusable elements requires analysis (separation of candidate components into primitives), qualification (evaluation of primitives for reusability according to reusability criteria), and loading (placing qualified elements into appropriate libraries). There can be different qualifications for different installations, methodologies, applications and components. Identifying reusable software and related components is labor-intensive and is best carried out as an integrated function of an SSE.

SOFTWARE SUPPORT ENVIRONMENT (SSE)

- o SOFTWARE FACTORY FOR PRODUCTION OF SPACE STATION PROGRAM OPERATIONAL SOFTWARE
 - TOOLS
 - RULES
 - PROCEDURES
 - HARDWARE SPECIFICATIONS
- o SSE CENTRALLY DEVELOPED AND MAINTAINED
- o SOFTWARE PRODUCTION FACILITIES AND THEIR PROJECTS ARE CONFIGURED FROM SSE



REUSABILITY DESIGN CONCEPT



INTERROGATION SUBSYSTEM APPROACH

- o **USE WELL-UNDERSTOOD, EXISTING DATA BASE TECHNOLOGY, AND TAXONOMIES**
- o **ALLOWS KEY WORD RETRIEVAL OF REUSABLE COMPONENTS**
- o **ALL RELATED COMPONENTS CAN BE IDENTIFIED AND RETRIEVED**
- o **IMPLEMENTATION WILL BUILD UPON EXISTING AND FUTURE INDUSTRY TAXONOMIES, TECHNIQUES, AND STANDARDS**

REUSE OF LIFE-CYCLE COMPONENTS

- o REUSE OF NON-CODE LIFE-CYCLE COMPONENTS IS REQUIRED**
- o NON-CODE COMPONENTS INCLUDE:**
 - REQUIREMENTS**
 - PRELIMINARY DESIGN PRODUCTS**
 - DETAILED DESIGN (ADA PDL)**
 - TESTS, TEST DATA, AND OTHER TESTING RESOURCES**
 - METHODS AND PROCEDURES FOR LIFE-CYCLE DEVELOPMENT**
 - TOOLS SUPPORTING DEVELOPMENT**
- o REUSABLE COMPONENTS CAN BE QUALIFIED FOR SPECIFIC:**
 - INSTALLATIONS**
 - METHODOLOGIES**
 - APPLICATIONS**
 - MISSIONS**

POSSIBLE TYPES OF REUSABLE LIFE-CYCLE COMPONENTS

- o TEMPLATES - OUTLINE FORM OF A COMPONENT**
- o GENERICS - TAILORABLE FORM OF A COMPONENT**
- o AS-IS - COMPONENTS REUSED WITHOUT MODIFICATION**

REUSING COMPONENTS

- o THIS APPROACH IDENTIFIES CANDIDATE COMPONENTS FOR REUSE SELECTION BY A DEVELOPER**
- o GENERICS AND TEMPLATES ARE COPIED TO USER'S WORK AREA FOR MODIFICATION PRIOR TO BEING PLACED UNDER CONFIGURATION CONTROL**
- o MODIFIED AND AS-IS COMPONENTS ARE LOADED DIRECTLY INTO AN SSE CONFIGURED OBJECT DATA BASE FOR TESTING**

REUSING COMPONENTS

- o **RELATED REUSABLE COMPONENTS IN LATER PHASES ARE LOADED INTO THE SSE PROJECT OBJECT BASE WHEN AN AS-IS REUSABLE IS SELECTED**
- o **IF AS-IS COMPONENT MUST BE REWORKED FOR THIS PROJECT, THE SSE MAY REQUIRE ITS DESCENDANTS TO BE REWORKED**
- o **ALL MODIFIED REUSABLES ARE CYCLED BACK TO REUSABLE LIBRARIES FOR QUALIFICATION AND LOADING INTO THE LIBRARIES**

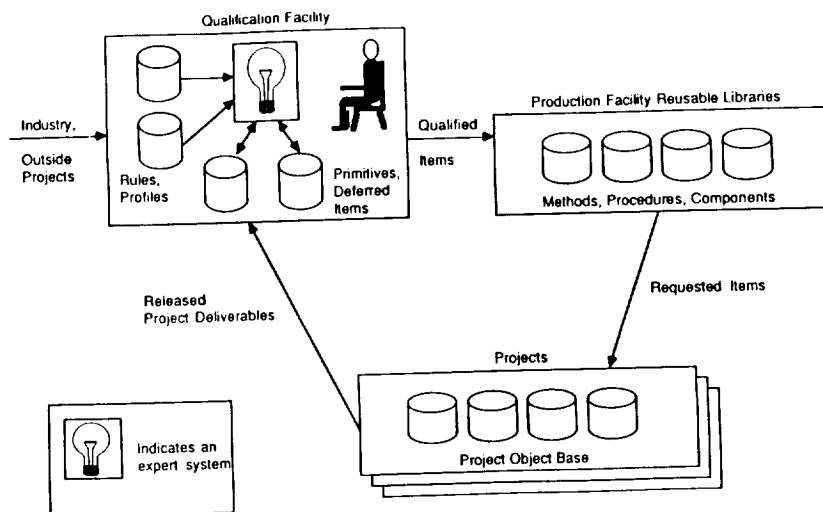
QUALIFICATION

- o **QUALIFICATION OF REUSABLE ELEMENTS REQUIRES:**
 - **ANALYSIS - SEPARATION OF CANDIDATE COMPONENT INTO PRIMITIVES**
 - **QUALIFICATION - EVALUATE PRIMITIVES FOR REUSABILITY ACCORDING TO REUSABILITY CRITERIA**
 - **LOADING - PLACING QUALIFIED ELEMENTS INTO APPROPRIATE LIBRARIES**
- o **MANUAL INTERROGATION ALLOWS FOR INDEPENDENT ASSESSMENT OF ELEMENTS BEFORE LOADING**
- o **QUALIFICATION RULES AND CRITERIA WOULD BE EVOLVABLE AND DEFINABLE TO REFLECT SITE/PROJECT/SYSTEM NEEDS**

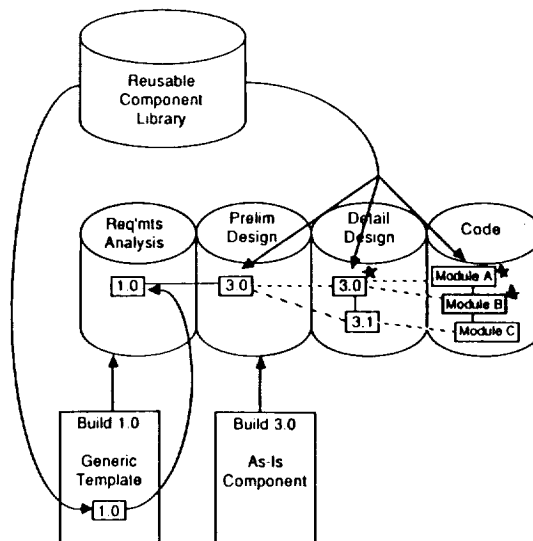
QUALIFICATION

- o **PRIMITIVE PROFILES WILL BE MODIFIABLE TO ACCOMMODATE NEW DEVELOPMENT TECHNIQUES OR TO ENFORCE STANDARDS**
- o **CAN HAVE DIFFERENT QUALIFICATION FOR DIFFERENT**
 - **INSTALLATIONS**
 - **METHODOLOGIES**
 - **APPLICATIONS**
 - **COMPONENTS (e.g., CODE vs. DESIGN)**

QUALIFICATION



QUALIFICATION



CONCLUSIONS

- o IT WAS DETERMINED THAT, IN SOME CASES, 60% OF THE SOFTWARE WAS REUSABLE
- o IDENTIFYING REUSABLE SOFTWARE AND RELATED COMPONENTS IS LABOR-INTENSIVE AND IS BEST CARRIED OUT AS AN INTEGRATED FUNCTION OF AN SSE
- o ADA PROVIDES SUPPORT FOR REUSE DURING ANALYSIS AND IDENTIFICATION, BUT SPECIAL CONSIDERATION MUST BE GIVEN TO STORAGE AND RETRIEVAL OF REUSABLE ADA COMPONENTS, INCLUDING THE MAINTENANCE OF RELATIONSHIPS BETWEEN CODE AND OTHER LIFE-CYCLE PRODUCTS
- o SOME ASPECTS OF AUTOMATING SOFTWARE REUSE, ENFORCING SOFTWARE DEVELOPMENT STANDARDS, AND AUTOMATING IV&V FUNCTIONS ARE SIMILAR
- o AI TECHNIQUES CAN BE APPLIED IN HARMONY WITH "CONVENTIONAL" SOFTWARE WHEN ATTACKING PROBLEMS WITHIN SSEs